FORM PTO-1390 (REV 5-93) U S DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

ATTORNEY'S DOCKET NUMBER 1959/49027

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

U S APPLICATION NO (if known, see 37 CFR 1 5) 09/600593

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/CH99/00013	13/01/1999 (January 13, 1999)	19/01/1998 (January 19, 1998)

TITLE OF INVENTION
UNIVERSAL JOINT FOR STEERING SHAFTS IN MOTOR VEHICLES

APPLICANT(S) FOR DO/EO/US
Christian LUTZ

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. [X] This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.

2. [ ] This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371

3. [ ] This express request to begin national examination procedures (35 U.S.C. 371(f) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).

4. [X] A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date

5. [X] A copy of the International Application as filed (35 U S C. 371(c)(2)).

   a. [X] is transmitted herewith (required only if not transmitted by the International Bureau).

   b. [ ] has been transmitted by the International Bureau

   c. [ ] is not required, as the application was filed in the United States Receiving Office (RO/US)

6. [X] A translation of the International Application into English (35 U.S.C 371(c)(2)).

7. [ ] Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C 371(c)(3))

   a. [ ] are transmitted herewith (required only if not transmitted by the International Bureau).

   b. [ ] have been transmitted by the International Bureau.

   c. [ ] have not been made; however, the time limit for making such amendments has NOT expired

   d. [ ] have not been made and will not be made.

8. [ ] A translation of the amendments to the claims under PCT Article 19 (35 U S.C. 371(c)(3)).

9. [X] An UNEXECUTED oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).

10. [ ] A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U S.C. 371(c)(5)).

Item 11. to 16. below concern other document(s) or information included:

11. [ ] An Information Disclosure Statement under 37 CFR 1.97 and 1.98.

12. [ ] An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3 28 and 3.31 is included.

13. [X] A FIRST preliminary amendment.

    [ ] A SECOND or SUBSEQUENT preliminary amendment

14. [ ] A substitute specification.

15. [ ] A change of power of attorney and/or address letter.

16. [ ] Other items or information:

U.S. APPLICATION NO (if known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO	ATTORNEY'S DOCKET NUMBER
09/600593	PCT/CH99/00013	1959/49027

17. [x] The following fees are submitted:	CALCULATIONS	PTO USE ONLY
Basic National Fee (37 CFR 1.492(a)(1)-(5)):		
Search Report has been prepared by the EPO or JPO ..... $840.00 International preliminary examination fee paid to USPTO (37 CFR 1.482) ..... $670.00 No international preliminary examination fee paid to USPTO (37 CFR 1.482)	$ 840.00	
but international search fee paid to USPTO (37 CFR 1.445(a)(2) ..... $760.00 Neither international preliminary examination fee (37 CFR 1.482) nor		
international search fee (37CFR 1.445(a)(2) paid to USPTO ..... $ 970.00 International preliminary examination fee paid to USPTO (37 CFR 1.482)		
and all claims satisfied provisions of PCT Article 33(2)-(4) $96.00		
ENTER APPROPRIATE BASIC FEE AMOUNT =	$ 840.00	
Surcharge of $130.00 for furnishing the oath or declaration later than [ ] 20 [X] 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	$ 130.00	

Claims	Number Filed	Number Extra	Rate	
Total Claims	19 -20=		X $18.00	$
Independent Claims	1 -3=		X $78.00	$
Multiple dependent claims(s) (if applicable)			+ $260.00	$
TOTAL OF ABOVE CALCULATIONS =				$ 970.00?

Reduction by 1/2 for filing by small entity, if applicable. Verified Small Entity statement must also be filed. (Note 37 CFR 1.9, 1.27, 1.28).	$
SUBTOTAL =	$ 970.00
Processing fee of $130.00 for furnishing the English translation later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(f)). +	$
TOTAL NATIONAL FEE =	$
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28,3.31). $40.00 per property +	$
TOTAL FEE ENCLOSED =	$ 970.00
Amount to be: refunded	$
charged	$

a. [X] One check in the amount of $ 970.00 for the filing fee is enclosed
b. [ ] Please charge my Deposit Account No. _____ in the amount of $_____ to cover the above fees A duplicate copy of this sheet is enclosed.
c. [X] The Commissioner is hereby authorized to charge any additional fees, which may be required, or credit any overpayment to Deposit Account No. 05-1323. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:
Evenson, McKeown, Edwards & Lenahan, P.L.L.C.
1200 G Street, N.W., Suite 700
Washington, D.C. 20005
Tel. No. (202) 628-8800
Fax No. (202) 628-8844

SIGNATURE

Donald D. Evenson

REGISTRATION NUMBER 26,160

July 19, 2000

Attorney Docket: 1959/49027
PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: CHRISTIAN LUTZ

Serial No.: NOT YET ASSIGNED Group Art Unit: NOT YET ASSIGNED

Filed: July 19, 2000 Examiner: NOT YET ASSIGNED

Title: UNIVERSAL JOINT FOR STEERING SHAFTS IN MOTOR VEHICLES

PRELIMINARY AMENDMENT

Box PCT
Commissioner for Patents
Washington, D.C. 20231

Sir:

Please enter the following amendments to the specification, claims and abstract prior to the examination of the application.

IN THE SPECIFICATION:

Please amend the specification as follows:

Page 1, line 3, delete ", pursuant to the preamble of claims 1" and insert -- with shaft ends fastened against rotation in the joint, these ends being held for movement in a housing joining the two joints and the shaft ends being joined together between the two joints by a ball joint so that the ball is mounted for rotation about its center point in a socket of the other shaft end and is slidingly movable in the direction of the shaft axis of the other shaft end --.

Page 2, lines 17-19, delete "the arrangement according to the specific part of claim 1 and claim 16" and insert -- providing a universal joint of the above-noted type with one of the following characterizing features; (i) the balls resiliently mounted in the socket; and (ii) an abutment arrangement for the ball and socket is arranged on the inner wall of the housing --.

Page 13, after line 10, insert -- The features of novelty which characterize the invention are pointed out with particularity in the claims annexed to and forming a part of this disclosure and are entirely based on the Swiss priority application. --

IN THE CLAIMS:

Please cancel all of the claims presently in the application and substitute new claims 20-38 as follows:

20. Steering shaft universal double joint for motor vehicles with shaft ends fastened against rotation in the joint, these ends being held for movement in a housing joining the two joints and the shaft ends being joined together between the two joints by a ball joint so that the ball is mounted for rotation about its center point in a socket of the other shaft end and is

slidingly movable in the direction of the shaft axis of the other shaft end,

wherein the ball is resiliently mounted in the socket, and

wherein the socket receives a slide bushing.

21. Joint according to claim 20,

wherein the bushing is held by a tumbler guide, the bushing being preferably enveloped at least partially by the tumbler guide.

22. Joint according to claim 20,

wherein the resilient mounting includes metal springs, preferably plate springs.

23. Joint according to claim 21,

wherein the resilient mounting includes is metal springs, preferably plate springs.

24. Joint according to claim 20,

wherein the resilient mounting includes elastomeric spring pads, preferably with annular pads between washers of, for example, metal.

25. Joint according to claim 23,

wherein the plate springs are biased against the tumbler guide, so that the shaft axis, when in the unstressed position, is aligned with the axis of the tumbler guide.

26. Joint according to any one of the foregoing claims,

wherein the bushing consists of a sintered metal, preferably with a supporting sleeve or a lubricant coating.

27. Joint according to claim 20,

wherein the bushing is slotted such that it is resiliently movable in a radial direction.

28. Joint according to claim 21,

wherein the bushing envelops the ball in a wear- and tolerance-equalizing manner in any working position, the bushing being installed in the tumbler guide with clearance approaching zero.

29. Joint according to claim 21,

wherein in an end portion of a fork, an annular chamber is formed to accommodate pre-biased resilient structure disposed between a first abutment on the fork side and a second abutment on the tumbler guide, so that the tumbler guide can tumble

resiliently about the shaft axis in case of radial action by a force.

30. Joint according to claim 21,

wherein the bushing is held in an axial direction at at least one end by the tumbler guide, preferably by a rim or by claws.

31. Joint according to claim 21,

wherein, between the bushing and the tumbler guide, a plastic sleeve, preferably slotted and tapered, and preferably of POM is provided, and it is preferably under pressure by a spring.

32. Joint according to claim 21,

wherein a plastic sliding guide is provided between the socket and the ball such that it receives the ball for rotational movement and is carried for sliding movement in the axial direction by the socket, the guide being preferably injection-molded directly onto the ball.

33. Joint according to claim 32,

wherein the socket has spring-finger-like structure on its circumference and resiliently grips the plastic sliding guide between ball and the socket.

34. Joint according to claim 32,

wherein the plastic sliding guide is enveloped in an outer wall area by a pre-biased plastic spring which slides in the socket, this spring preferably having slots in its circumference, so that it can breathe in the radial direction.

35. Joint according to claim 33,

wherein the plastic sliding guide is enveloped in an outer wall area by a pre-biased plastic spring which slides in the socket, this spring preferably having slots in its circumference, so that it can breathe in the radial direction.

36. Joint according to claim 20,

wherein on an inner wall of the housing an abutment structure is provided for the ball and the socket.

37. Joint according to claim 36,

wherein the abutment structure is so configured that the ball and the socket define given allowable positions in all extreme joint deflections and in the case of assembly, the

abutment structure being so configured that in case of abutment first the socket and then the ball makes contact.

38. Joint according to claim 20,

wherein the universal joint contains a homokinetic joint, such as a constant velocity joint and/or preferably a cross joint.

IN THE ABSTRACT OF THE DISCLOSURE

Please add the Abstract of the Disclosure submitted herewith on a separate page for the original Abstract presently in the application.

REMARKS

Entry of the amendments to the specification and claims before examination of the application is respectfully requested. These claims have been amended to remove multiple dependencies.

If there are any questions regarding this Preliminary Amendment or this application in general, a telephone call to the undersigned would be appreciated since this should expedite the prosecution of the application for all concerned.

It is respectfully requested that, if necessary to effect a timely response, this paper be considered as a Petition for an Extension of Time sufficient to effect a timely response and shortages in other fees, be charged, or any overpayment in fees

be credited, to the Account of Evenson, McKeown, Edwards & Lenahan, P.L.L.C., Deposit Account No. 05-1323 (Docket #1959/49027).

Respectfully submitted,

July 19, 2000

Donald D. Evenson
Registration No. 26,160

EVENSON, McKEOWN, EDWARDS
& LENAHAN
1200 G Street, N.W., Suite 700
Washington, DC 20005
Telephone No.: (202) 628-8800
Facsimile No.: (202) 628-8844
DDE/rrt

Attorney Docket No.1959/49027
PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

SPECIFICATION

INVENTION: **UNIVERSAL JOINT FOR STEERING SHAFTS IN MOTOR VEHICLES**

INVENTOR: **Christian LUTZ**
Citizenship: German
Post Office Address/ Residence: Im Daneu 25a
A-6714 Nüziders
Austria

ATTORNEYS: **EVENSON, McKEOWN, EDWARDS & LENAHAN, P.L.L.C.**

Suite 700
1200 G Street, N.W
Washington, D.C. 20005
Telephone No.: (202) 628-8800
Facsimile No.: (202) 628-8844

Translation of PCT/CH99/00013
Attorney Docket Number 1959/49027

UNIVERSAL JOINT FOR STEERING SHAFTS IN MOTOR VEHICLES

The invention relates to a steering shaft universal joint for motor vehicles, pursuant to the preamble of claim 1.

One known double joint system is, for example, the double-cross universal joint with a ball joint disposed between the two joint crosses. In known systems of universal joints, two joint crosses are connected movably around the one joint cross axis by a fork on each of the two shaft ends and movably about the other joint axis to a connecting housing. The centering is performed by a jointed connection of the two shaft ends within the connecting housing of a metal joint ball at the one end of the shaft and a cylindrical socket, also of metal, on the other shaft end into which the joint ball enters. The connecting housing forms a hollow space in the interior, which creates a free space for the movement of the centering joint coupling and its size is proportional to the maximum angular deflection of the two shaft ends with respect to the extended axis. The ends or stubs of the two crosses are mounted for ease of movement, for example on rolling bearings which are situated in bores in the fork arms and in the connecting housing, respectively. The universal joint mounting with its eight bearing points as well as the central ball mounting requires great precision to be able to assure easy movement of the universal joint. A slight misalignment of the two shaft axes within the plane of deflection can result in jamming in certain positions, which can greatly interfere with ease of movement. Moreover this also leads to undesirable wear.

To limit such disadvantages the bearings must be made with sufficient precision, which results in greater cost of manufacture. Another known possibility for reducing the problem is to provide rubber-elastic material as an insert around the stubs of the universal bearing such that the bearings will be able, with the easy elastic movement thus achieved, to adjust to the manufacturing tolerances and at the same time have a vibration damping action. A rubber-elastic support of two to all eight universal joint stubs is restrictive when small sizes are required, and it is difficult and expensive to achieve.

The present invention is addressed to the problem of proposing a steering shaft universal joint in which the disadvantages of the state of the art are eliminated. In particular, the problem consists in achieving a double joint which in addition to ease of movement is easy to install, inexpensive to make, and insensitive to production tolerances.

The problem is solved according to the invention by the arrangement according to the specific part of claim 1 and claim 16. The dependent claims define additional advantageous embodiments.

According to the invention, the socket for the balls which link the two shaft ends together is made for tumbling resiliently or spring elastically. This is possible with very low fatigue and adjustable spring force. This allows a very low-cost

configuration, since the equalization of tolerances by the resilient journaling needs to be performed only once.

The ball on the one shaft extremity is preferably held in the socket of the other shaft extremity such that the socket for the ball is configured as a slide bushing and this bushing envelops the ball. The bushing in turn is resiliently mounted in that the bushing or the socket which can contain the slide bushing can be fastened through resilient means such as springs to the one shaft extremity and to the fork, respectively, such that the socket, in case of excessive radial forces, can be pushed away by the ball in a kind of tumbling movement, until the tolerance is compensated.

The slide bushing in which the ball slides and turns is made from a sliding bearing material, and such a bushing can also have a lubricant coating. Especially suitable, however, are bushings made from a sintered metal on a supporting sleeve.

The bushing itself should be made such that together with the ball it forms a bearing with no free play. This is achieved by the fact that the slide bushing makes spring-elastic contact with the ball with a certain bias and thus without free play. Slotting the outer wall of the slide bushing makes this possible so that the slide bushing can breathe in the radial direction. In this manner both radial tolerances, for example those of the ball diameter, are absorbed and departures from tolerances of the

shaft are equalized through the resilient mounting of the bushing.

Another advantageous embodiment consists in the fact that a plastic guide is applied to the ball of the joint, and then the plastic guide itself slides in the slide bushing or the cylindrical socket. In this case it is possible to manufacture the bushing or the socket even without any special bearing material. The bearing bushing can even be omitted and the plastic part holding the ball then glides with direct guidance in the bearing sleeve which is resiliently mounted for tumbling movement.

In universal joint systems especially of the kind mentioned above it is furthermore important that, when the joint is assembled, a guide means is present which brings the ball joint together in a selective manner, and furthermore that in extreme-end positions of the joint, which do not correspond to normal operations, a defined abutment is provided for safety reasons. By designing the junction housing accordingly in the internal area with corresponding rotting abutment surfaces this can be established. Care must be taken that especially the tumbler socket which in some cases bears the bushing will first engage the abutment in the extreme position and only then contact the ball of the joint at a second abutment surface. This assures, especially in the uninstalled condition, that contact in the extreme position is cushioned. This kind of abutment definition is especially

suitable for the present resilient ball joint bearing according to the invention, but it can also be used to advantage in other universal joints without resilient ball joint bearing.

Other embodiments of cross joints are also suitable for universal joint systems. If, for example, especially great ease of movement and uniform motion are required, the double joint is advantageously made with a universal joint, also called a constant velocity joint, especially of the Gleichlauf-Festgelenk type. Between the two joints, which are joined together by a housing, the ball joint is again arranged with the resilient mounting, so that the shaft extremities are mounted for flexural movement through the two joints. Constant velocity joints are manufactured as "Löbro-Gelenke" by Löhr & Bromkamp GmbH, DE 6050 Offenbach.

The invention shall now be described with the aid of embodiments and diagrammatic figures, wherein:

Fig. 1 shows schematically and in section an embodiment according to the invention of a steering shaft double-cross universal joint.

Fig. 2 shows schematically and in section another embodiment according to the invention of a steering shaft double-

cross universal joint rotated 90° and with abutment means to limit deflection.

Fig. 3 shows schematically and in section, an enlargement according to Figure 2, of a variant of the resilient bearing system of the tumbler sleeve with bushing.

Fig. 4 shows schematically and in section another variant of the resilient bearing system with a flanged tumbler sleeve.

Fig. 5 shows schematically and in section another variant of the resilient bearing system with free play compensating spring fingers.

Fig. 5a shows schematically and in section a spring finger according to Fig. 5.

Fig. 6 shows schematically and in section an additional free play compensating variant, also with a plastic sleeve of adjustable diameter between the tumbler socket and the slide bushing to compensate for tolerances and wear.

Fig. 7 shows schematically and in section another variant with a plastic frictional guiding means held on the

ball and the tumbler socket configured as a slide bushing.

Fig. 8 shows schematically and in section an embodiment corresponding to Figure 7 with the tumbler socket configured as a spring adjusting to zero free play for the plastic frictional guiding means.

Fig. 8a shows schematically and in section the tumbler socket according to Fig. 8.

Fig. 9a shows schematically and in section another embodiment of a plastic frictional guiding means with plastic spring, in the uninstalled state.

Fig. 9b shows schematically and in section the plastic frictional guiding means with plastic spring corresponding to Figure 9a.

Fig. 10a schematically shows in cross-section, a plastic guide according to Figure 9, shown in an installed position

Fig. 10b schematically and in a longitudinal cross-section, a plastic guiding means according to Figure 9, also in an installed condition.

A steering shaft double-cross universal joint according to the invention is represented in Figures 1 and 2. The joint consists of a coupling case 8 and a tubular dual fork 8, respectively, in which two joint crosses 9 are mounted for movement. The shaft ends 2 and 3 are jointed on one another by means of the forks 4 and 6 which are journaled on the joint crosses 9, and to the socket 7 by the ball neck 10 and the balls 5. Bellows can protect the joint against dirt.

The socket 7 is configured as a sliding sleeve or accommodates a cylindrical bushing which is coated either with an antifriction material, for example an antifriction metal, such as preferably a sintered metal with supporting sleeve. To permit an appropriate equalization of tolerances, the socket 7 is mounted resiliently to the fork 6, so as to be deflected in a tumbling manner with respect to the shaft axis 3 by a certain transverse force. The bias of the plate spring 31 is selected such that a sufficiently great restoring force is present and the tolerance equalization is assured combined with ease of operation.

In Figure 2 there is shown in cross section a joint rotated 90 degrees, in which the forks 4 and 6 are represented at the shaft ends 1 and 2. The latter can be movably inserted, as mentioned, in the crosses 9 on the casing 8, which can be tubular, for example. In the central inner area of the housing the end abutments 13 and 14 are represented, which are in the form of annular raised portions and are helpful until the joint is

assembled, and serve simultaneously as safety abutments in extreme terminal positions of the joint. The abutment surfaces 13 and 14 are configured such that the socket 7 when in the extreme position with respect to the ball 5 will first make movement-limiting contact with the abutment 13.

The bushing 11, which is shown in cross section in Figure 3, is advantageously interrupted by a slot 15 so that the bushing can breathe radially and can be fitted with bias onto the ball 5. This brings it about that the bushing 11 rotates and/or slides on the ball 5 without clearance. The slot 15 can be created either lengthwise of the shaft or in spiral form or in any other way that interrupts the wall.

Another possibility for increasing the springing action of the bushing 11 or provide for additional damping consists, in addition to the tumbler bearing on the fork 6, in applying a rubber-elastic material between the bushing 11 and the socket 7.

In Figure 3 is shown how the socket 7 can be held on the fork with bias as a tumbler socket 7 by springs 31. On account of the great bias force that is to be applied and the small amount of space available, plate springs are preferred. They furthermore are less expensive. Another appropriate spring mounting is possible by the use of rubber-elastic pads which can be in

annular form, for example, held between metal disks. This can be done if necessary in a layered configuration.

In Figure 3 it is furthermore to be seen that the plate springs 31 are held advantageously in an annular chamber 34 which is formed at the end of fork 6. In the upper half of the figure the tumbler guide means 7, 30, is provided with a flange 33 which serves as a spring abutment and is urged against another flange 41 configured as a holding lip or claw, so that, in the rest position, it is aligned axially with the shaft axis. The claw 41 furthermore holds the friction bearing in an axial position.

In the bottom half another variant of the tumbler sleeve mounting is shown; here the tumbler sleeve 30 is urged by springs 31 abutting rim 33 against the rim 35 on the fork side. The springs 31 in that case thrust against the rim or lip 41 forming the chamber 34; for assembly they are held on the socket 7. The bushing 11 is advantageously affixed to the tumbler socket 7 by holding means 32, 32.2. Advantageously this is accomplished by rim 32, at least on the side of bushing 11 remote from the fork 6. The hook of the rim 32 should overlap the bushing 11 at least to the extent that, when wear occurs and free play results it will not drop out. At the other end of the bushing 11 a retaining projection 32.1 can be provided which holds the bushing 11 in place in the other axial direction.

Additional possibilities for the bearing are represented in Figure 4. In the upper half of the figure a rim 32.2 clutches the fork 6 on the side facing away from the ball of a projection 42. The springs 31 are held between the front side of the projection 42 and a rim of the bushing 22 forming an annular chamber 34.

As represented in Figures 5 and 5a, the bushing 11 can additionally be held resiliently by spring fingers 38, the latter being provided or formed on the tumbler sleeve 30. This provides additional compensation for tolerances.

The use of a preferably adapting plastic sleeve 36, between the bushing 11 and the tumbler guide, according to Figure 6, additionally permits the free play of the bearing to be held closer to zero by compensating for wear and it simplifies assembly. The tapering shape of the plastic sleeve 36 and tumble guide 7,30 additionally improves adjustment to zero free play. The plastic sleeve can be shaped in an appropriate manner, preferably tapering and likewise slotted, so that the bushing 11 is fixed, for example by lugs which overlap the bushing 11 at its extremity. It is advantageous if a spring 31.1 urges the taper adaptably. A suitable plastic is chiefly POM, but also PA, PA and GF.

Another possibility for simplifying the bearing, as shown in Figure 7, consists in omitting the metal bushing 11 and providing

a rotatory plastic friction bearing 37 on the ball, which is held for axial sliding movement in the tumbler guide 30, 7. An additional slight compensation of free play can be accomplished by spring lips which rub with pressure on the ball surface in the deflected joint and axially displace the plastic bearing in play.

As represented in Figures 8, 8a and 8b, the system can be further improved by making the cylindrical tumbler guide 7, 30, spring-elastic in its wall area, and having it surround the plastic sliding guide 37 without clearance and even compensating in case of wear. This is easy to accomplish by appropriate choice of material and by providing slots which interrupt the wall in some areas and thus form resilient spring fingers 38. This embodiment can be made at especially low cost and makes the joint easy to assemble. Additional advantages are the large-surface contact with the ball and thus less wear, good damping of shocks and a great selection of appropriate materials such as POM, PA, PA + GF, as well as plastic and carbon fiber materials which have particularly good lubricant properties. POM in this case is especially suitable and low in cost. In addition, slots in the central area of the sliding guide 37 can be shaped to form spring lips 37.1 in order to surround the ball 5 resiliently with still less clearance.

The variant in Figures 9b and 9a shows in longitudinal and cross section an additional preferred possibility for a damping compensation of free play in the unbiased state. The plastic

sliding guide 37 is provided in its outer wall area with a plastic spring 39, which permits sliding without free play under bias V. The spring 39 is preferably made in one piece with the plastic guide 37, the spring being preferably slotted 40 so that it can breathe radially and being in contact with the inside surface of the tumbler guide 30 in a wear and tolerance equalizing manner. In Figure 10 the same plastic sliding guide as in Figure 9 is shown in the installed state. The tolerance gaps A, B, which the spring spans with respect to thetumbler guide 30, are shown schematically.

IN THE CLAIMS:

1. Steering shaft universal double joint for motor vehicles with shaft ends (1, 2) fastened against rotation in the joint, these ends being held for movement in a housing (8) joining the two joints (9) and the shaft ends (1, 2) being joined together between the two joints by a ball joint (5, 7) so that the ball (5) is mounted for rotation about its center point in a socket (7) of the other shaft end (1) and is slidingly movable in the direction of the shaft axis (3) of the other shaft end (2), characterized in that the ball (5) is resiliently mounted (11, 37) in the socket (7).

2. Joint according to claim 1, characterized in that the socket (7) is formed as a resiliently mounted bushing (11), and the bushing (11) is preferably mounted resiliently in the socket (7) for tumbler movement.

3. Joint according to claim 2, characterized in that the bushing (11) is held by a tumbler guide (30), the bushing (11) being preferably enveloped at least partially by the tumbler guide.

4. Joint according to any one of the foregoing claims, characterized in that the mounting is performed with metal springs (31), preferably with plate springs (31).

5. Joint according to any one of the foregoing claims, characterized in that the mounting is performed with elastomeric spring pads, preferably with annular pads between washers of, for example, metal.

6. Joint according to claim 4, characterized in that the plate springs (31) are biased against the tumbler guide (30), so that the shaft axis (30) when in the unstressed position, is aligned with the axis of the tumbler guide (30).

7. Joint according to any one of the foregoing claims, characterized in that the bushing (11) consists of a sintered metal, preferably with a supporting sleeve or a lubricant coating.

8. Joint according to any one of the foregoing claims, characterized in that the bushing (11) is slotted such that it is resiliently movable in the radial direction.

9. Joint according to any one of the foregoing claims, characterized in that the bushing (11) envelops the ball in a wear- and tolerance-equalizing manner in any working position, the bushing (11) being installed in the tumbler guide (7, 30) with clearance approaching zero.

10. Joint according to any one of the foregoing claims, characterized in that in the end portion of the fork (6) an annular chamber (34) is formed to accommodate pre-biased resilient means (31), the latter being disposed between a first abutment (35, 41) on the fork side and a second abutment (33) on the tumbler guide (30), so that the tumbler guide (30) can tumble resiliently about the shaft axis in case of radial action by a force.

11. Joint according to any one of the foregoing claims, characterized in that the bushing (11) is held in the axial direction at at least one end by the tumbler guide (30), preferably by a rim (32) or by claws (32, 1).

12. Joint according to any one of the foregoing claims, characterized in that between the bushing (11) and the tumbler guide (30) a plastic sleeve (36), preferably slotted and tapered, and preferably of POM is provided, and it is preferably under pressure by a spring 31.1

13. Joint according to any one of the foregoing claims, characterized in that between the sleeve-like socket (7) and the ball (5) a plastic sliding guide (37) is provided such that it receives the ball (5) for rotational movement and is carried for sliding movement in the axial direction by the socket, the guide (37) being preferably injection-molded directly onto the ball (5).

14. Joint according to claim 13, characterized in that the socket (7) has spring-finger-like means on its circumference and resiliently grips the plastic sliding guide (37) between ball (5) and socket (7).

15. Joint according to claim 13 or 14, characterized in that the plastic sliding guide (37) is enveloped in the outer wall area by a pre-biased plastic spring (39) which slides in the socket (7, 30), this spring (39) preferably having slots (40) in its circumference, so that it can breathe in the radial direction.

16. Steering shaft universal joint for motor vehicles with shaft ends (1, 2) held against rotation in the joint, which are mounted for movement in a housing (8) joining together the two joints, and the shaft ends (1, 2) being joined together between the two joints by a ball joint (5, 7), so that the ball (5) at the one shaft end (2) is mounted in a socket (7) of the other shaft end (1) for rotation about its center and is mounted in the direction of the shaft axis (3) of the other shaft end (2), characterized in that on the inner wall of the housing (8) an abutment means (13, 14) are provided for the ball (5) and the socket (7).

17. Joint according to claim 16, characterized in that the abutment means (13, 14) are so configured that the ball (5) and the socket (7) define the given allowable positions in all extreme joint deflections and in the case of assembly, the means (13, 14) being so configured that in case of abutment first the socket (7) and then the ball (5) makes contact.

18. Use of the abutment means according to claim 16 or 17 in a joint according to any one of claims 1 to 15.

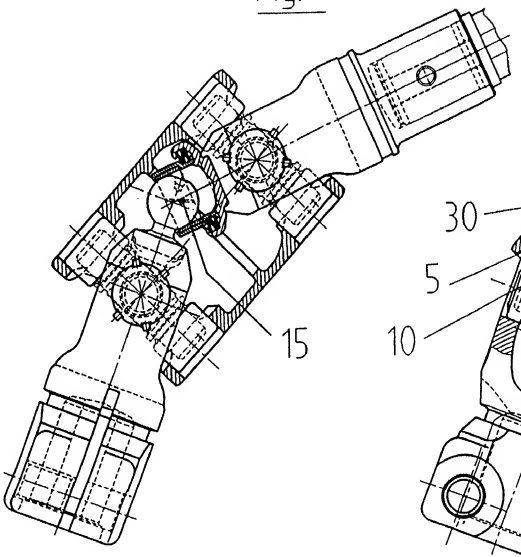
19. Joint according to any one of the foregoing claims, characterized in that the universal joint contains a homokinetic joint, such as a constant velocity joint and/or preferably a cross joint.

Serial No.

-- ABSTRACT OF THE DISCLOSURE

A steering shaft universal joint assembly for motor vehicles as provided. Shaft ends are fastened against rotation in the joint, the ends being held in a housing joint adjoining the two joints with interposition of a ball joint so that the ball of the ball joint is mounted for rotation about its center point in a socket of one shaft end and is slidingly movable in a direction of the shaft axis of the other shaft end. The ball is resiliently mounted in the socket and the socket receives a slide bushing. --

Fig. 1



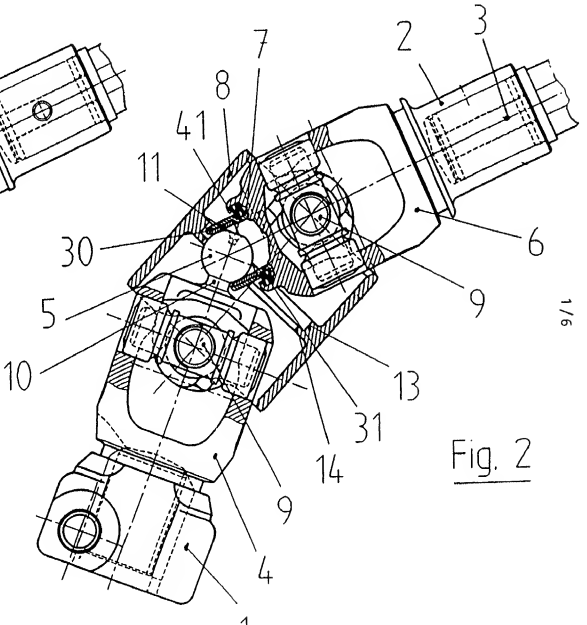


Fig. 2

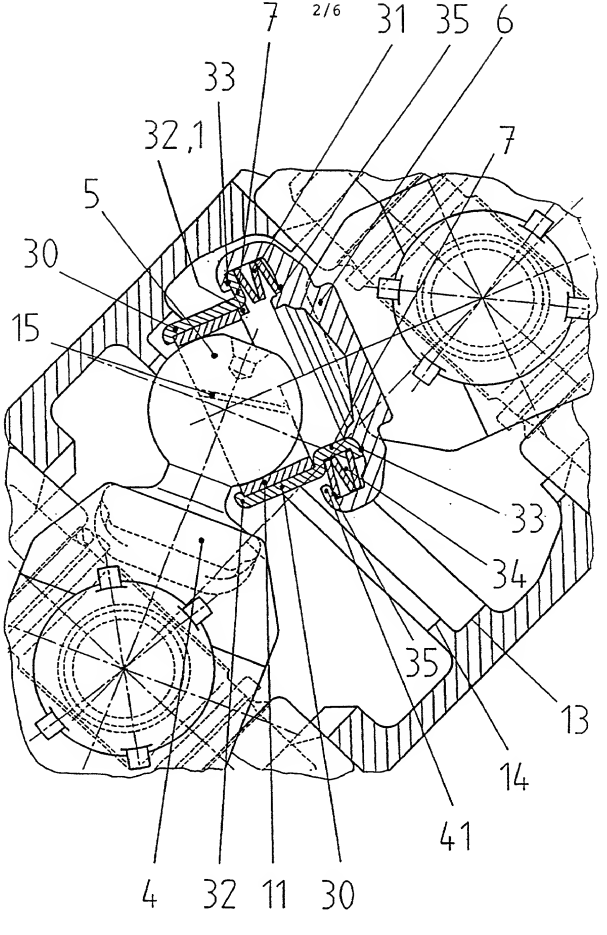


Fig. 3

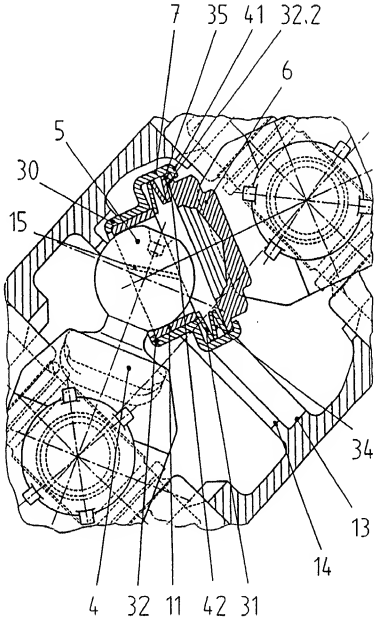


Fig. 4

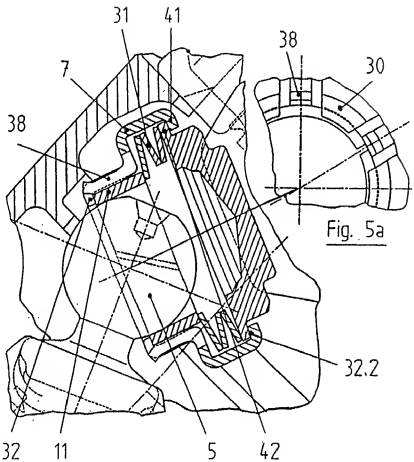


Fig. 5a

Fig. 5

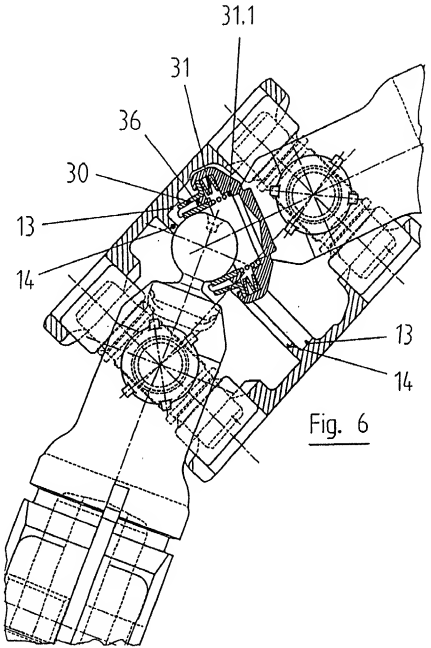


Fig. 6

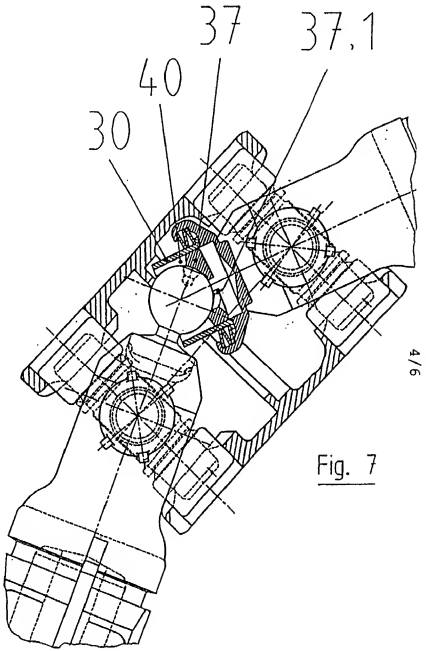


Fig. 7

Fig. 8

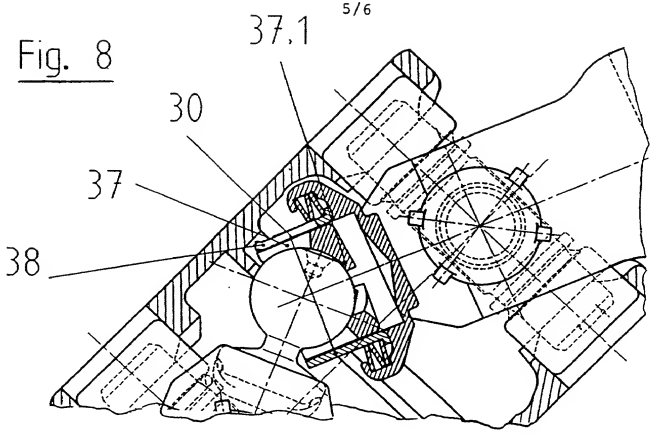


Fig. 8b

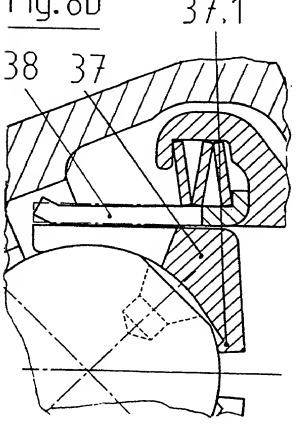
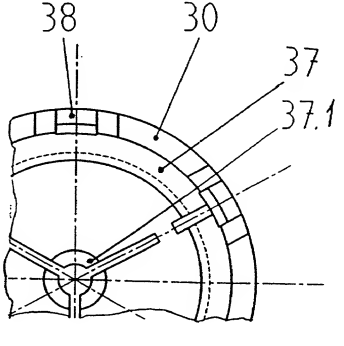


Fig. 8a



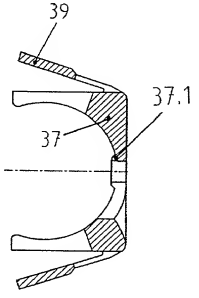


Fig. 9b

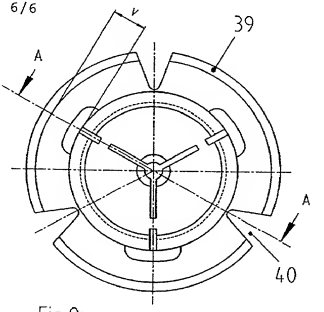


Fig. 9a

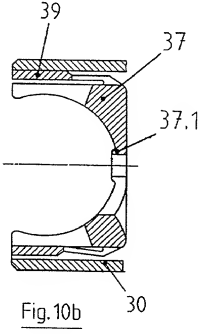


Fig. 10b

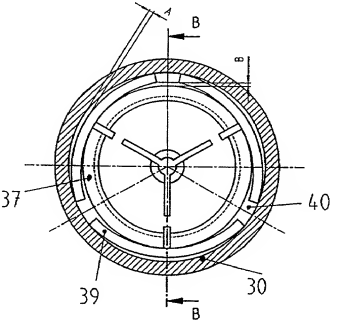


Fig. 10a

DECLARATION AND POWER OF ATTORNEY - PATENT APPLICATION

As a below named inventor, I hereby declare that my citizenship, postal address and residence are as stated below; that I verily believe I am the original, first and sole inventor (if only one inventor is named below) or a joint inventor (if plural inventors are named below) of the invention entitled:

UNIVERSAL JOINT FOR STEERING SHAFTS IN MOTOR VEHICLES

the specification of which

____ is attached hereto, or

__X__ was filed on January 13, 1999 as PCT Application No. PCT/CH99/00013 and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above. I acknowledge the duty to disclose all information known to be material to patentability as defined in 37 CFR §1.56. I hereby claim foreign priority benefits under Title 35, United States Code §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)			Priority Claimed
108/98 (Number)	Switzerland (Country)	19 / 01 / 98 (Day/Month/Year)	YES
(Number)	(Country)	(Day/Month/Year)	

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose all information known to be material to patentability as defined in 37 CFR §1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

(Application Serial No.)	(Filing Date)	(Status)

I hereby appoint as principal attorneys Herbert I. Cantor, Reg. No. 24,392; James F. McKeown, Reg. No. 25,406; Donald D. Evenson, Reg. No. 26,160; Joseph D. Evans, Reg. No. 26,269; Gary R. Edwards, Reg. No. 31,824; and Jeffrey D. Sanok, Reg. No. 32,169, to prosecute and transact all business in the Patent and Trademark Office connected with this application and any related United States and international applications. Please direct all communications to:

Evenson, McKeown, Edwards & Lenahan, P.L.L.C.
1200 G Street, N.W., Suite 700
Washington, D.C. 20005
Telephone: (202) 628-8800
Facsimile: (202) 628-8844

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under §1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

DECLARATION AND POWER OF ATTORNEY
Page 2

INVENTOR:	**Christian LUTZ**
Citizenship:	Austria
Post Office Address/ Residence:	Im Daneu 25a A-6714 Nüziders Austria

AUX
Krupp Presta AG
FL-9492 Eschen

28. August 2000
(date)

Christian Lutz
(signature of inventor)